Open Systems — Fielding Superior Combat Capability Quicker

Joint Task Force Talks About Understanding and Implementing a Successful Open Systems Approach

TRISH BRYAN

Dr. Paul G. Kaminski, [then] Under Secretary of Defense for Acquisition and Technology, in one of his many speeches outlining the Department of Defense's (DoD) acquisition reform initiatives, said, "At DoD, it's our responsibility to make sure that we always have access to cutting-edge technologies and products. Open systems help prevent us from being locked into proprietary technology." He went on to say that this was one of many reasons why the Department's senior leadership is thoroughly committed to the open systems approach.

Because of that commitment, he formed the Open Systems Joint Task Force in 1994 to establish an open systems approach as the foundation for all weapons systems acquisitions within the Department of Defense.

DICK MCNAMARA AND LARRY YUNG DISCUSS THE APPLICATION OF OPEN SYSTEMS IN THE NSSN AND CRUSADER PROGRAMS.

A New Way of Thinking

The open systems approach is an integrated technical and business strategy that defines key interfaces for a system or piece of equipment. It calls for the project manager to...

- adopt standard interfaces; and
- acquire (not develop) components, while still...
  - integrating components; and
  - using and supporting the system.

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"As a standards-based technical approach as well as a preferred business strategy, the open systems approach serves to enable improved weapons systems performance, lower life-cycle costs, and fielding of superior combat capability quicker."

Bryan is an Analyst at BRTRC Technology Research Corporation, Fairfax, Va.

Photos courtesy BRTRC

"Our most compelling story is showing program managers and senior project staff real-life examples where open systems are being used successfully."

—Lennie Burke

Director,
Open Systems
Joint Task Force

the open systems approach serves to enable improved weapons systems performance, lower life-cycle costs, and fielding of superior combat capability quicker.

In an effort to broaden the scope of knowledge and promote the use of an open systems approach, the Task Force provides training, workshops, case studies, assessments, and technical assistance to Program Offices.

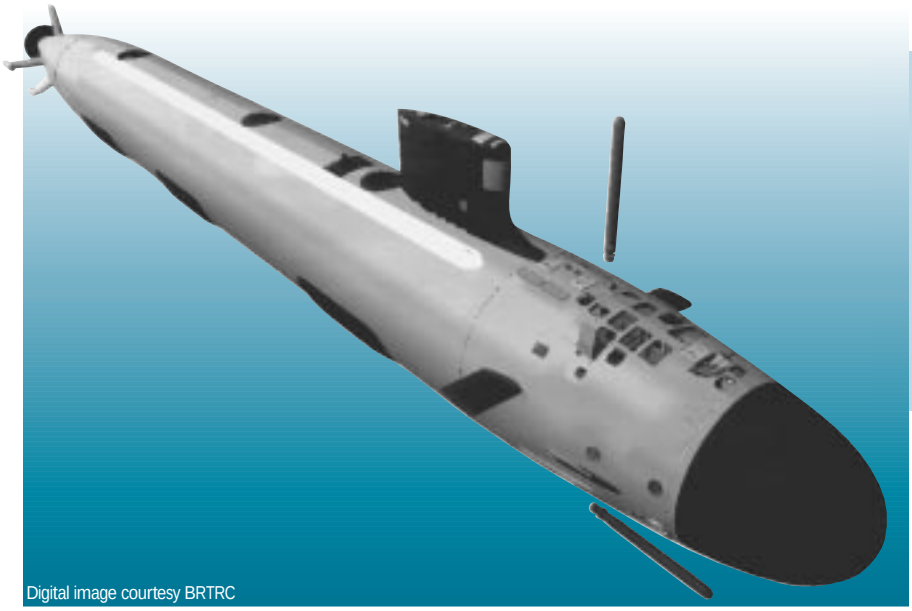
The Open Systems Joint Task Force

For the benefit of *Program Manager* readers, the Open Systems Joint Task Force Director recently met with three acquisition managers to discuss the obstacles, benefits, and ultimately, the successful implementation of the open systems approach for their individual programs.

H. Leonard "Lennie" Burke, Director, Open Systems Joint Task Force: *Over the last four years, the Open Systems Joint Task Force has briefed a lot of people on the open systems approach, developed educational workshops, and generally gotten the word out that open systems reduces life-cycle costs and improves performance in new and legacy weapon systems. Yet, our most compelling story is showing program managers and senior project staff real-life examples from programs [like those managed by many of* Program Manager's *readers], where open systems are being used successfully.*

To further that effort, I've assembled several people with experience implementing open systems to talk about why they chose

ACQUISITION MANAGERS, MARINE COL. JIM FEIGLEY, LENNIE BURKE, DICK MCNAMARA, AND LARRY YUNG MEET TO DISCUSS THE OPEN SYSTEMS APPROACH AS IT AFFECTS THEIR RESPECTIVE PROGRAMS.



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THE NAVY'S NEW ATTACK SUBMARINE (NSSN) IS THE NEXT GENERATION REPLACEMENT FOR THE SEAWOLF-CLASS SUBMARINE. THE NSSN WILL BE THE NAVY'S UNDERSEA WEAPON OF CHOICE FOR THE 21ST CENTURY. WITH UNSURPASSED QUIETING, STATE-OF-THE-ART COMPUTER TECHNOLOGY, AND PRECISION TARGETING CAPABILITY, THE NSSN WILL BE THE MOST ADVANCED WEAPONS DELIVERY SYSTEM IN THE WORLD.

an open systems strategy, what obstacles they encountered, what recommendations they have for other program managers. Let's begin with a brief description of each one's program and how it incorporates open systems.

Richard "Dick" R. McNamara, Technical Director of the New Attack Submarine Command, Control, Communications, and Intelligence (C^3I) System Program Office: I represent the Navy's New Attack Submarine, the next generation replacement for the SEAWOLF. The SEAWOLF was capable but too expensive, so affordability was "Job No. 1" for the NSSN. To make sure it was affordable, we adopted a Commercial-off-the-Shelf (COTS) and open systems approach to the ships C^3I systems early in the design and acquisition process.

We also established an open systems definition development process in which the Navy and industry jointly defined COTS applications and specific open systems standards and profiles that we later used in our competitive procurement for the C^3I system. Our choice of COTS and open systems gives us the greatest flexibility to do technology insertion downstream and, at the same time, ensure that the NSSN remains current, capable, and affordable.

"It took an intensive effort with industry and some critical item testing early on; but, we eventually gained confidence that open systems would add value and reduce costs in our program."

—Dick McNamara

C^3I System Technical Director, NSSN

Lock "Larry" F. Yung, Chief, Command, Control, Communications, and Computers (C^4I) Product Development Team for the Crusader: The Crusader is a cannon artillery weapon system consisting of a self-propelled howitzer and companion resupply vehicle. It's a new-start program with both vehicles under the same project manager to minimize interface problems and to maximize the possibility of reuse of hardware and software between the vehicles.

With regard to open systems, we spelled it out in the contract. We wanted the software to port between the two vehicles; we wanted the contractor to use Army C^4I Technical Architecture standards; we wanted redundancy written into the design so if one processor fails, the function can be picked up by another. From our perspective, there was every advantage to be gained by pushing our contractor to adopt an open systems strategy.

Marine Col. James "Jim" M. Feigley, Direct Reporting Program Manager for the Advanced Amphibious Assault Office: AAAV is a self-deploying, fully tracked, armored amphibious personnel carrier designed to get Marine infantry units from ships to inland objectives as quickly as possible. Once ashore, it moves troops and provides direct fire support. Basically, the AAAV is part high-speed landing craft; part armored personnel carrier.

Two factors drove our decision to implement an open systems approach. First, we needed to keep pace with technology. To do this, we identified elements that were technically volatile, primarily electronics, and made sure the system

THE FASTEST, QUIETEST, MOST HEAVILY ARMED NUCLEAR-POWERED ATTACK SUBMARINE IN THE WORLD, SEAWOLF (SSN 21), WAS COMMISSIONED ON JULY 19, 1997, AT ELECTRIC BOAT SHIPYARD IN GROTON, CONN. SEAWOLF IS THE FIRST "TOP TO BOTTOM" NEW ATTACK SUBMARINE DESIGN SINCE THE SKIPJACK CLASS IN THE EARLY 1960S. THE BENCHMARK FOR UNDERWATER EXCELLENCE, THREE SEAWOLF-CLASS SUBMARINES HAVE BEEN AUTHORIZED BY CONGRESS. ITS INHERENT STEALTH, COUPLED WITH STATE-OF-THE-ART SENSORS AND ADVANCED COMBAT SYSTEMS MAKE IT ONE OF THE WORLD'S MOST FORMIDABLE WEAPONS SYSTEMS.

DoD digitized photo

design accommodated new technology as it came along.

Second, we defined the elements that would consume big bucks in the operations and sustainment phase and made some choices up-front that would reduce the overall cost of ownership. Open systems architecture made sense as a way of addressing both of these issues. Plus, from a user perspective, it gave us the opportunity to provide the Marine with a system that can be consistently modernized and updated from an operational point of view.

Burke: *This ability to provide a state-of-the-art system over the life of the system and reduce life-cycle cost that Jim talked about – was it just as important in the NSSN program?*

McNamara: Very much so. Submarines take about seven years to build from the time they are authorized to when they are turned over to the Navy. If we can build a system that delivers in three years using COTS components, we've got about three generations of technology to go through before we assume ownership. So, as you can see, technology refreshment prior to delivery is critical to ensuring a product that is technically up-to-date.

We also challenged industry to streamline the system by using a fixed price incentive production contract in which the contractor shares with the government, on a 50/50 basis, any cost underruns from their original production bid. Under this arrangement, every component the contractor removes from the system's design reflects potential profit. The contractor now has an incentive to sell us what we asked for, to reduce piece parts, and to exploit new technology as it comes online.

Yung: We've all seen examples of systems electronics becoming obsolete before the vehicle is fielded. That's because we used to pick a technology strategy early in the process. This effectively froze the technology to the system. For example, if we specified a 486 processor, we stayed with a 486 through production because that was what our software ran on. Since so much of our expense was in the software arena, we've learned our lesson. Now, we ask the contractor to keep the design flexible so upgrades can be made easily as new technology is introduced.

As a result of this strategy, maintenance costs have come down; upgrades are much more efficient. We also wait until later in the process to nail down electronics specifics; what took place in Generation I before, now happens in Generation II design or even later.

Burke: *So far, we seem to agree there are a lot of benefits in using an open systems approach. But, I've been told by other program managers that there are a lot of obstacles as well. Let's talk about some of the difficulties you've encountered; a few that come to my mind are lack of a defined process, budget inflexibility, lack of training, politics.*

McNamara: The biggest obstacle we faced was ignorance or the perception that open systems and COTS are just the latest fad. As Technical Director for the NSSN C^3I System, I took a step back and said..."I'm from Missouri; *show me* how this benefits my program." It took an intensive effort with industry and some critical item testing early on; but, we eventually gained confidence that open systems would add value and reduce costs in our program.

Burke: *That's a good point, Dick. In other words, it's not enough to include open systems in your RFP [Request for Proposal] and just hope for the best; you have to work the issue, invest some time and some money, and have a plan.*

McNamara: Absolutely.

Burke: *Jim, what kind of obstacles did you encounter in the AAAV program?*

Feigley: We didn't characterize them as obstacles...we had "challenges." One of them was our ability to communicate what we wanted because everyone has a different impression of what you mean by "open systems." You need to under-

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THE CRUSADER IS AN ADVANCED CANNON FIELD ARTILLERY WEAPON SYSTEM CONSISTING OF A SELF-PROPELLED HOWITZER AND COMPANION RESUPPLY VEHICLE. A NEW-START PROGRAM, CRUSADER HAS THE SAME PROJECT MANAGER FOR BOTH VEHICLES TO MINIMIZE INTERFACE PROBLEMS AND TO MAXIMIZE THE POSSIBILITY OF REUSE OF HARDWARE AND SOFTWARE BETWEEN THE VEHICLES.

stand it internally before you try to explain it externally. And, you need to make sure your vision gets down to the people who are charged with day-to-day responsibility of implementing open systems. This is an often overlooked but, nevertheless, critical element if you're going to accomplish what you set out to do.

Another challenge is that open systems can be perceived as a threat. On one hand, we encourage our prime contractors to develop long-term agreements with suppliers to help them improve products and processes. On the other, open systems encourages competition so we can choose the best product at the lowest cost. These concepts are not at odds as long as the contractor performs as expected. In fact, if the relationship is working, the subcontractor has an opportunity to introduce his latest products; if it doesn't pan out, the government has an opportunity to change. It's really a win-win situation for both sides.

Yung: We spent a lot of time educating our people, both contractors and project team members, using a briefing that outlines what we expect in terms of open systems architecture. Since we have different teams working on different parts of the project – for example, one team is evaluating and selecting the operating system, another determines the interfaces, a third develops the electronic architecture – this is an excellent way to keep everyone up-to-speed and make sure the hardware and software are in sync.

"Since so much of our expense was in the software arena, we've learned our lesson. Now, we ask the contractor to keep the design flexible so upgrades can be made easily as new technology is introduced."

—Larry Yung

Chief, C⁴ Product Development Team, Crusader

Burke: *At the Task Force, we describe open systems as* ***an integrated technical and business strategy.*** *For example, Dick you talked about how you've ensured that NSSN technology will be up-to-date at time of delivery. Jim, you mentioned your concerns vis-à-vis the potential conflict between building long-term relationships and encouraging multiple sources of supply. Did open systems impact your technical and business decisions, and do you see the two as being related?*

McNamara: There's no question that open systems impacted a lot of our decisions. Probably the biggest fear we have is that our prime contractor will pick the wrong standard or wrong path, and we'll be dead-ended. Open systems helps ameliorate the potential of this becoming a reality by encouraging our prime contractors to develop relationships with several vendors so they aren't banking on a single supplier to carry them into the future.

We also let it be known that we represent a significant market; that second-tier competitions will be run, and there are certain criteria we expect vendors to meet. For example, we need to be satisfied they'll be around to provide support over the life cycle of a system if we use their product.

More and more, we find our prime contractors are assuming the role of "integrators," not builders/, developers. It's a different way of doing business, not un-

like when we did "catalog engineering" for analog systems during the '60s. Then we looked up capacitors and diodes, got the price, and ordered. The digital market we're entering now, because of open systems, will bring us back to that way of doing business. Our catalog is on the Internet; open systems is the tool that allows vendors to design and produce timely and high-performance products that can be measured and compared to each other.

Feigley: We are constantly reminded that business decisions impact technical decisions and vice versa. For example, if we identify some system capability we'd like to have but it's too theoretical, too volatile, or too expensive to get it, our technical decision would impact cost. If we make a business decision to keep our options open to the greatest degree possible by having multiple choices for the system architecture, performance could be better or worse depending on our selection.

Right now, we're looking at several choices for our propulsion plant and suspension systems. We've taken the next step and developed tech demonstrators which may look alike on the outside but are very different on the inside. As long as the performance to the user is transparent, there's no reason why we can't use prototypes and other avenues available to us to physically demonstrate the viability of the system before we commit to one configuration over another.

Burke: *Good point, Jim. That also gives suppliers an opportunity to incorporate new technology, innovate to increase performance at lower cost, and still meet that same interface. If they know where the product is going, what your performance requirements are, they can better use their resources to develop a better product in response. This is where the real leverage of open systems comes into play.*

That leads me to another question. Jim, the NSSN and Crusader program's use of open systems primarily focuses on electronics. Is there a different approach with mechanical systems you work with in the AAAV program?

Feigley: The nature of mechanical systems makes it a little more difficult to do open systems than with electrical systems. For example, there's a conflict between open systems architecture and mechanical systems as it relates to design efficiency. With electronics, boards are boards, chips are chips; they won't get a lot bigger or a lot smaller, just more powerful.

In a mechanical system, if you want a certain part of the design to have an open systems architecture — like the engine for example — the choice you make can mean there are significant differences in physical size and weight, even though performance may be the same and the price is competitive. You may have to accept a little penalty from a design elegance point of view as it relates to efficient use of space.

McNamara: I should point out that even though my main focus is combat systems, the NSSN uses COTS and open systems to the greatest degree possible on mechanical applications as well. The air conditioning system is industry standard; the diesel generators are commercial quality; and, although our initial purchase of generators was from Caterpillar, our design can accommodate another vendor down the line. Of course, we also encounter some very unique areas like noise quieting for hydraulic valves. Even in these unique areas, we try to minimize the number of variants and stabilize interfaces so that, within our own little domain, we have open systems products.

Burke: *One of the fundamental reasons for using open systems is reducing the cost of ownership. Yet, at the time most of these programs are structured and funded, cost of ownership numbers are just a projection, which some would say are pretty unreliable just because [most of the programs] are so far in the future. Some of you have already referred to up-front decisions and expenditures that were made with total life-cycle cost reduction in mind; how did you "sell" yearly savings in Year 1 of the project?*

Feigley: By making a case that the open systems approach reduces risk. In any program, there's an element of risk; performance risk, technical risk, cost risk. It's an acknowledged part of the process. One of the best arguments we have is that open systems can reduce risk and, by extension, cost of ownership.

McNamara: We did something called "design to affordability." With design to affordability, we provided a set of common ground rules and then asked each offeror to make some life-cycle projections for their proposed system so we could compare each offeror's implementation over the life cycle. What we found was that approaches focusing on unique, proprietary designs were more expensive over the life cycle and could not accommodate technology insertion as readily as those approaches relying on COTS and open systems.

Burke: *That's another good example of the relationship between the business strategy and the technical strategy.*

McNamara: We've seen very different philosophies in the application of COTS and open systems. Both can be illustrated by what I call the "bathtub curve." On this curve, the initial expense of a new technology is high...you're right at the top. Cost starts to go down as production matures and eventually reaches the bottom of the curve. When the technology gets real old, you start up the curve again, up the other side of the tub toward higher costs. One approach is an off-the-shelf strategy, refreshing technology at 18- to 24-month intervals — always buying the technology at the bottom of the curve and making the design accommodate the new technology. Other philosophies reflect a "push the technology" strategy, which calls for a very high investment in technology at the front end that is intended to forestall any need for refreshment in the future.

Burke: *There's a terrible downside risk on that one if you guess wrong.*

McNamara: Absolutely. Frankly, I was surprised to find that such differences existed. It appears to reflect a difference in cultures in industry. One culture is fa-

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THE ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV), CURRENTLY BEING DEVELOPED BY LAND SYSTEMS, GENERAL DYNAMICS, WILL BE CAPABLE OF TRANSPORTING 18 MARINES AND A CREW OF THREE OVER WATER AT SPEEDS OF 29 MILES PER HOUR; THE DESIGN USES A PLANING HULL PROPELLED BY TWO WATER JETS. ON LAND, AAAV WILL ACHIEVE SPEEDS OF 45 MILES AN HOUR, WITH CROSS-COUNTRY MOBILITY GREATER THAN THAT OF AN M1A1 TANK.

miliar with COTS and open systems, and recognizes their value for facilitating technology insertion. The other is founded in building unique products optimized for specific purposes.

Yung: In the Crusader program, cost is equally as important as performance, and our contracting process reflects that. We select a contractor first...and then work concurrently with them through the proposal, evaluation, and negotiation phase. Our people actually sit side-by-side with the contractors, helping them identify a concept that will satisfy our requirements. One of the advantages is a tighter cost estimate because we know precisely what we're buying; but, more importantly, we can apply cost as an independent variable (CAIV) as we develop the systems concept, so we can make those cost/performance tradeoffs early in the program when they have the greatest impact.

Burke: *Let me share another take on this from a program I was involved in called OSCAR (Open System Common Avionics Requirements), which called for adding capabilities to the AV-8B Harrier II aircraft. If one took the short-term view of the program, the solution was to do some minor software revisions in the mission computer to get the capability they needed. When it was done, the computer would be at 100-percent utilization for cycle time and memory.*

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—Marine Col. Jim Feigley

Direct Reporting Program Manager, AAAV

The opposing view was to put a new computer in the airplane and rewrite the operational flight program (software) so it would be flexible in the future. This was obviously the "right" way to go but it would cost more money – around $60 million – and deliver the same capability in the short term! Obviously we had some convincing to do.

So we showed them the chart that accompanies this article [see next page]. Clearly, if the Marine Corps Aviation didn't care about OSCAR after the year 2000, my argument wasn't going to work. On the other hand, if we did what we'd always done with our airplanes – which is to add capabilities, make performance changes, deal with obsolescence – we could demonstrate tremendous payoffs in the operations and sustainment phase if we put in the new computer.

The extra $60 million up-front would mean that OSCAR would pay for itself in five to six years. Using open systems and planning for technology insertion, modifications, upgrades, we could smooth out the upward trend of spending that starts in the fifth or sixth year and save money from that point on and continuing throughout the total life cycle. It's a tough sell, but it can be done.

That brings me to another question: How important is the ability to reuse assets within a system and/or to go across a domain to similar platforms and reuse some hardware or software element on both platforms? Larry, what about the Crusader?

Yung: We just embarked on a joint program between Bradley and Crusader to

develop an operating environment that provides all the services or utilities that your operating system or application requires. Our thinking is that if the two vehicles share a common operating system, the application will be transparent to the hardware, and the software can be used by both.

We're taking this a step further by looking at the Force Battle Command Brigade and Below (FBCB2) software being developed for Army XXI, which the Army intends to designate as its standard software to ensure all systems are interoperable and users can communicate. We are doing our best to make sure that our contractor doesn't duplicate a product that's already been developed.

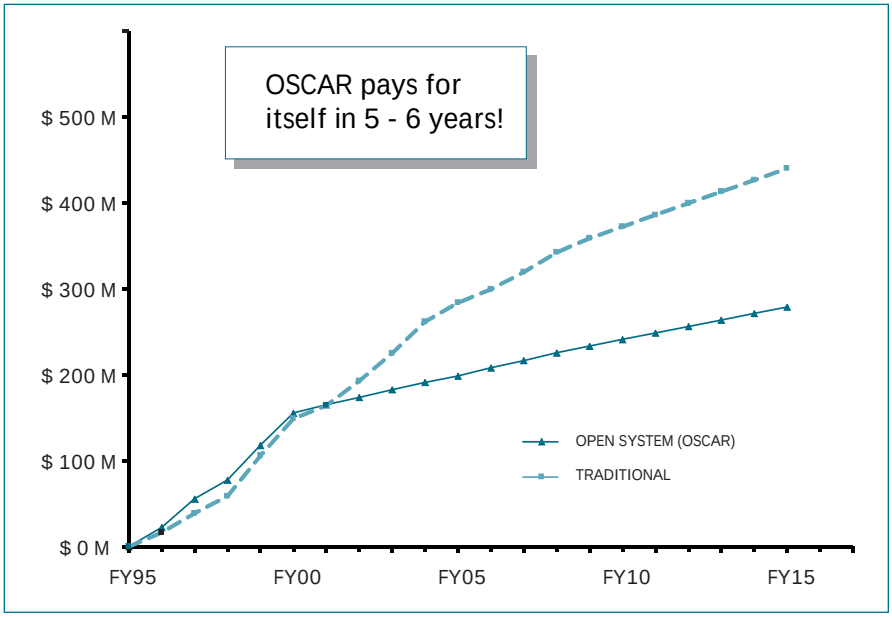
Feigley: We think stealing good ideas from others is the highest form of flattery; conversely, we believe the Marine Corps' mission *requires* us to take a leading edge system like AAAV and backfit it or spread it out to other items and other programs.

In our case, we're looking at radios in the Special Forces; we've taken pieces off the Bradley and the Marine Corps' M1 main battle tank. The light armored vehicle is looking at items on AAAV that they can use in their systems, and the Navy's newest class of amphibious ships is considering putting our gun on their ship, which means the ship and the vehicle on the ship would have common ammunition, common guns, common spares, etc.

We're seeing a strong impetus to use elements we've developed for the AAAV in other weapons platforms because we are out in-front in terms of modernization vis-à-vis other items in the force.

Burke: *Is that centrally managed, or is it up to the entrepreneurial behavior of the program manager to look at cross-platform capability?*

Feigley: In the Marine Corps, we have a clearinghouse called the AAAV General Officer Executive Steering Committee. We meet every six to eight weeks and discuss these kinds of issues.



OSCAR Projected Life Cycle Cost Savings

McNamara: The Navy equivalent was the Force Warfare System Engineering Board. There are also a number of executive steering groups being set up where program managers can say, "What have you got that I can use?" Obviously, open system in this context really becomes an enabler; the ability to swap hardware, electronics, software, etc., is a lot easier than it would be if you've got a proprietary system and/or closed architecture.

Burke: *It's relatively easy to do open systems in a new start program versus incorporating the approach into a legacy program. In your experience, is your strategy different with legacy systems, and can open systems still be implemented effectively in programs with big sunk costs in systems design?*

McNamara: I've had some experience because the backfit community for submarines has benefited a lot from the NSSN. The key, I think, is not to use "sunk" cost as an excuse to continue going downstream in the wrong direction. Unless a system is so highly integrated that it simply won't work, you can pick a portion of your system, define an interface, and then work backward from there using COTS and open systems to replicate or upgrade capabilities. The biggest obstacle to overcome in getting open systems into legacy systems is inertia. It's easier for people to do things the way they've always been done.

Yung: How you sell the concept of moving from closed to open systems is critical. If you tell someone you want to spend $60 million to do a block upgrade so the system will be "open," it probably won't fly. But, if you approach it from the perspective that the $60 million will improve performance of the system and — oh, by the way, it will make it easier to upgrade from that point on because it will be an open system — there's a chance it will be implemented.

Feigley: In the Corps, performance is important; but readiness is even more important. You have the best of all worlds if you can make the case that open systems upgrade performance, cost less, and sustain readiness at the highest level.

Burke: *If someone said to you, "I've read every word in this* Program Manager *article and it sounds great...but where do I start?" — what would you tell them?*

Feigley: From an economic standpoint, I'd give them the "Willie Sutton" philosophy...When he was asked why he robbed banks, he said, "because that's where the money is." Look at the life-cycle cost estimate of your program; see where the big operations and support dollars are, and start there. Forget what's

on the margin and go for the big stuff that can really have an impact on reducing total cost.

McNamara: I would add that once you've decided which areas to attack, you should educate yourself on how to apply open systems. At the risk of sounding like your public relations representative, Lennie, I'd advise program managers to get in touch with the Open Systems Joint Task Force. I know you've got workshops because I've participated in beta testing for some of them. Your literature, especially the case studies, stimulate thinking about how open systems might be applied to other programs.

Yung: Nothing beats actual experience. You can tell people how well open systems works, but they only develop a level of understanding and commitment after they go through the process. One of the key factors, from my perspective, is having a "champion" — someone who will work open systems day in and day out. I'd also second what Dick and Jim said...identify areas with high volatility, systems that will be impacted by advances in technology, or where history shows the most upgrades have taken place. Use those to demonstrate why open systems is the right approach.

Editor's Note: For more information on open systems, contact the Open Systems Joint Task Force:

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About the Task Force Members

H. Leonard "Lennie" Burke is the Director of the Open Systems Joint Task Force. Burke sponsors and accelerates the adoption of an open systems approach for all DoD weapons systems electronics. Lennie is an expert in the area of avionics, having previously served as Technical Director of the Avionics Division for the Naval Air Systems Command. His understanding of requirements for one of the most demanding environments — military and electronic avionics design — and his in-depth knowledge of open systems policies, processes, and applications qualify Burke as an expert on the open systems approach.

Richard "Dick" R. McNamara has provided technical direction and leadership for complex acoustic, mechanical, and electronic combat and weapon systems for more than 28 years in various positions in the Naval Undersea Warfare Center, Naval Sea Systems Command, Office of the Assistant Secretary of the Navy for Research, Development, and Acquisition, and the Program Executive Officer for Submarines. As Technical Director of the New Attack Submarine Command, Control, Communications, and Intelligence (C^3I) System Program Office, McNamara currently plans and directs technical activities of the New Attack Submarine's C^3I System and ancillary electronics systems.

Lock "Larry" F. Yung has more than 20 years of experience in development, evaluation, and testing of ground combat vehicle fire control systems. He has supported the Army's M60A3 Tank, Abrams Main Battle Tank, and the Bradley Fighting Vehicle. As the Chief of the Command, Control, Communications, and Computers (C^4I) Product Development Team for the Crusader, Yung is responsible for development of vehicle electronics, software architecture, operating systems, crew station design, and fire control/battlefield management systems.

Marine Col. James "Jim" M. Feigley currently serves as the Direct Reporting Program Manager for the Advanced Amphibious Assault Office. Commissioned in 1973, Feigley has played a leadership role over the last 10 years in Marine Corps' initiatives to upgrade its fleet of assault vehicles. His areas of special expertise include amphibious tracked vehicles and acquisition management.

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